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Simulation Based Reliability & Safety (SimBRS) Program FY08 – FY12

SEN Cochran - Staff

9 May 2011

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Report Documentation Page			Form Approved OMB No. 0704-0188		
<p>Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.</p>					
1. REPORT DATE 09 MAY 2011	2. REPORT TYPE N/A	3. DATES COVERED -			
4. TITLE AND SUBTITLE Simulation Based Reliability & Safety (SimBRS) Program FY08-FY12			5a. CONTRACT NUMBER		
			5b. GRANT NUMBER		
			5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S)			5d. PROJECT NUMBER		
			5e. TASK NUMBER		
			5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) US Army RDECOM-TARDEC 6501 E 11 Mile Rd Warren, MI 48397-5000, USA			8. PERFORMING ORGANIZATION REPORT NUMBER 21805		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) US Army RDECOM-TARDEC 6501 E 11 Mile Rd Warren, MI 48397-5000, USA			10. SPONSOR/MONITOR'S ACRONYM(S) TACOM/TARDEC/RDECOM		
			11. SPONSOR/MONITOR'S REPORT NUMBER(S) 21805		
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited					
13. SUPPLEMENTARY NOTES Presented to SEN Cochran and Staff, The original document contains color images.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF: b. ABSTRACT unclassified			17. LIMITATION OF ABSTRACT SAR	18. NUMBER OF PAGES 19	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	c. THIS PAGE unclassified				

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- Provides full life-cycle engineering support and is provider-of-first-choice for all DOD ground combat and combat support vehicle systems.
- Develops and integrates the right technology solutions to improve Current Force effectiveness and provide superior capabilities for the Future Force.



Responsible for Research, Development and Engineering Support to 2,800 Army systems and many of the Army's and DOD's Top Joint Warfighter Development Programs

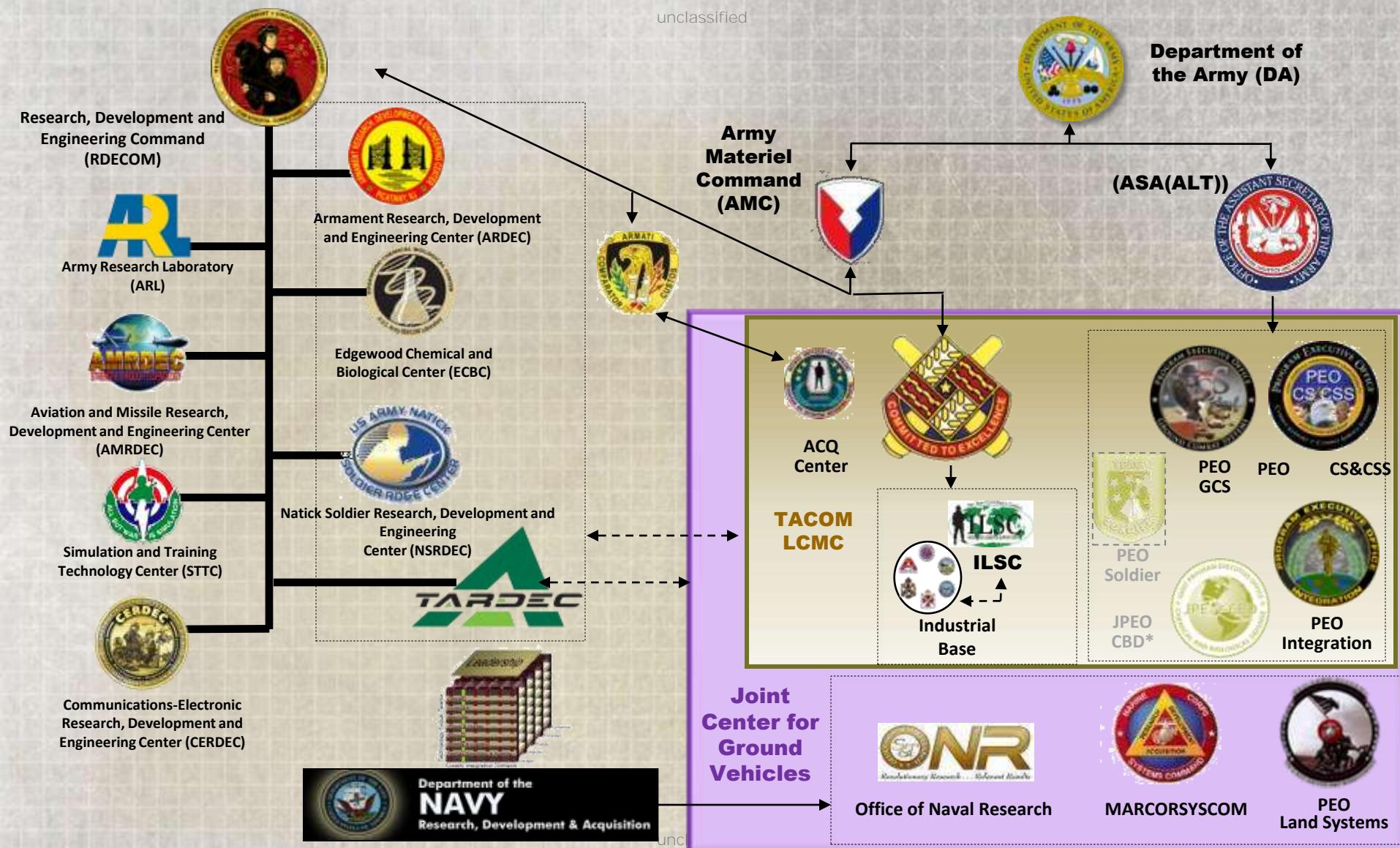
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Ground Systems Enterprise



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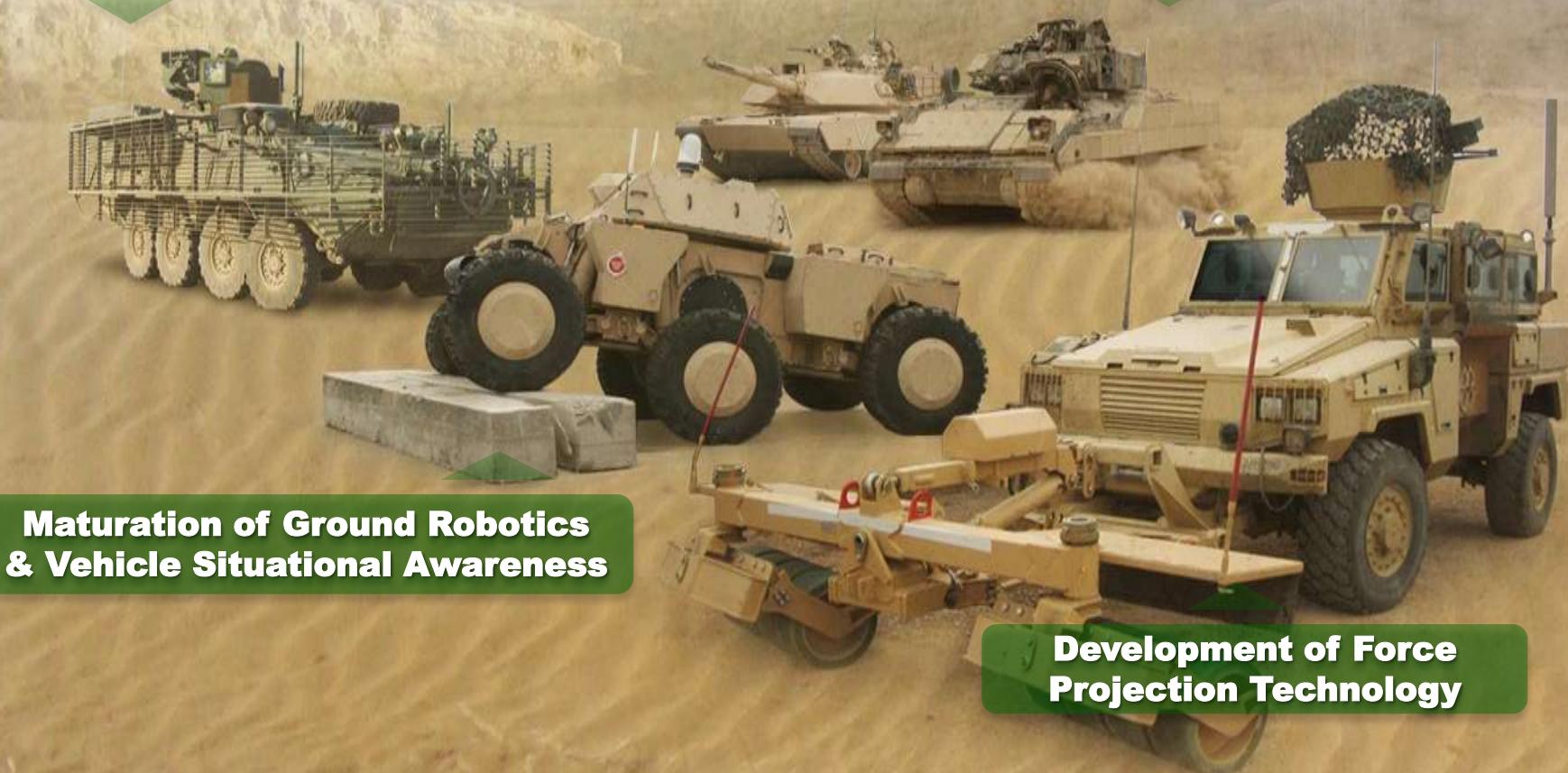
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**Ground Systems
Survivability Integration**

**Vehicle Electronics &
Architecture Integration**

**Ground Systems
Power & Mobility Integration**



**Maturation of Ground Robotics
& Vehicle Situational Awareness**

**Development of Force
Projection Technology**

Systems Engineering & Integration Excellence Across the Life Cycle

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Advanced Conceiving



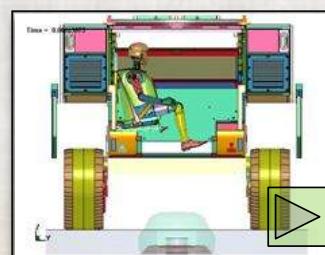
JLTV



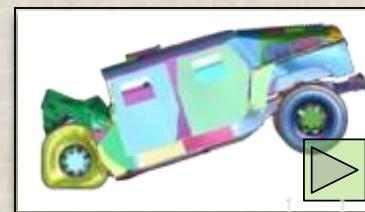
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MRAP

Analytics



Blast

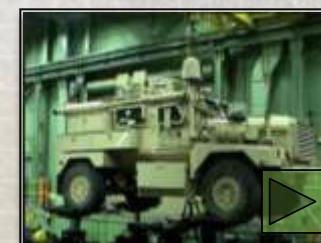


Structures/Durability



Crew Safety

Hardware & Man-In-The-Loop Simulation



MRAP



Turret Test



Characterization

Prototype & Demonstrators



APD

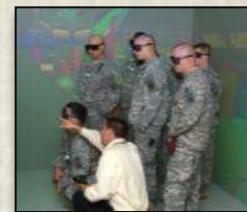


FED

HPC & Data Management



High Performance Computing (HPC)



Computer Aided Virtual Environment (CAVE)



Advanced Collaborative Environment (ACE)

Providing rapid assessment and integration services throughout the Life Cycle of both Technology and System/Platform Development Programs.

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Geographic Benefits

- Defense Industry Ground Systems Hub
- Direct Linkage to World-Class Automotive Research and Development Centers
- Connected to World-Class Automotive Engineering Universities at our doorstep
- Strategic Engagement with Automotive Supplier Network



MichiganTech

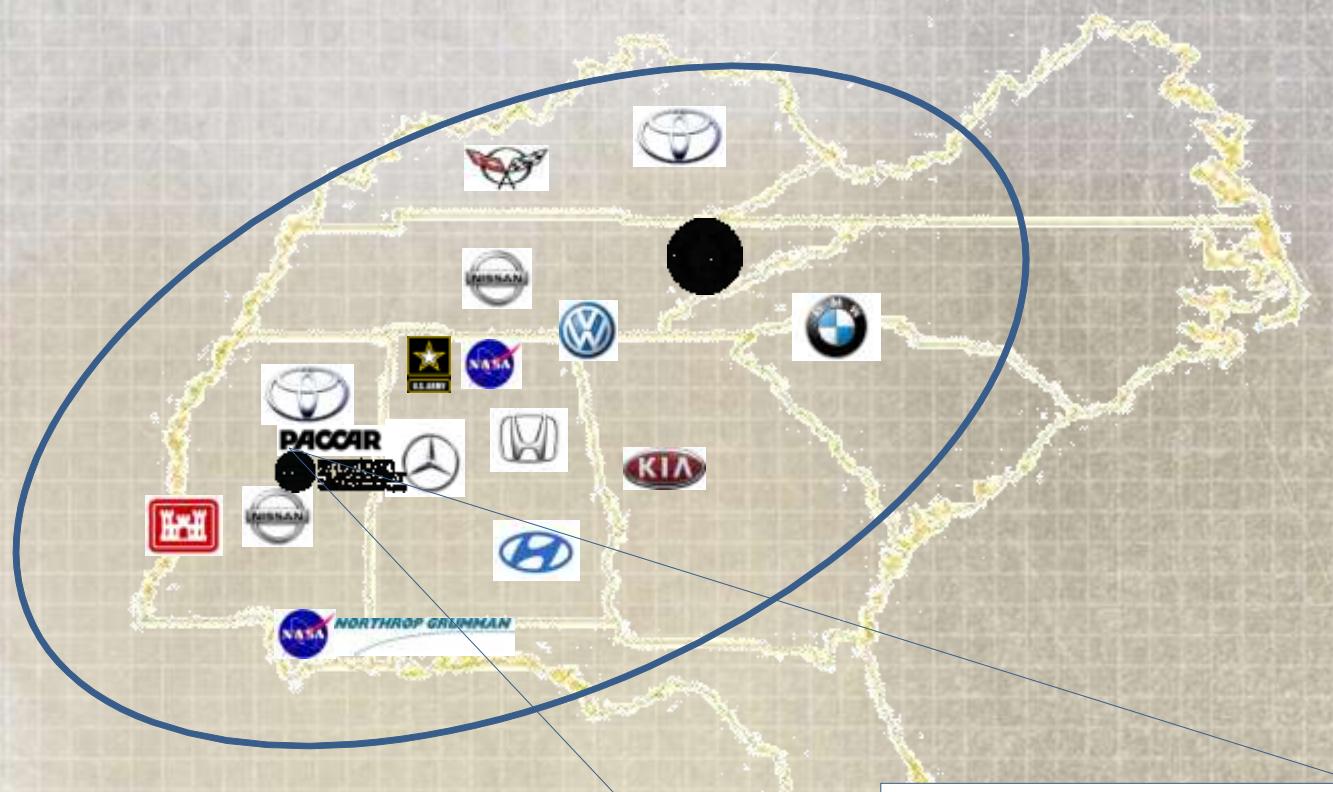


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Most Robust Automotive Engineering Expertise & Academia Institutions in the World

Strategic Relationships in the Southeast

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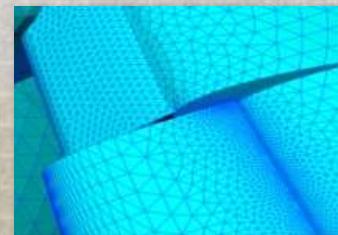
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Center for Advanced Vehicular Systems

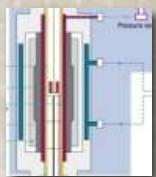
- Semiconductor Devices Motion
- Capture & Virtual Reality (VR)
- Industrial Ergonomics
- Mechanical Testing
- Materials Characterization
- 6-DOF Motion Base Driving Simulator



Computational Fluid Dynamics



Subsystems: On-Board Vehicle Power



Thermal Analysis System



3D X-ray Tomography



High Resolution In-situ FEG-SEM



Computational Structural Mechanics



Metamodelling-based Optimization

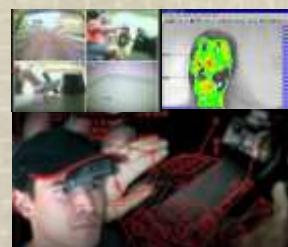


Design Optimization

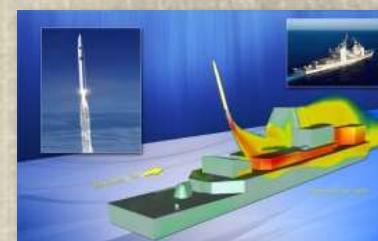
Significant Accomplishment & Milestone



NSF Engineering Research Center for Computational Field Simulation 1990-2001



Digital Human and Cognitive Modeling



Technology Impact Missle Intel/Defense
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Driving Simulators

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The Simulation Based Reliability and Safety (SimBRS) research program is a university and industry consortium to improve vehicle safety, survivability and reliability.

- **Mission:** The SimBRS Program is focused to meet the Army's needs in developing advanced M&S tools, working through a collaborative academic & industry environment, partnering as a consortium and working with TARDEC.
- **Vision:** To create a world class industry leading consortium developing modeling and simulation tools for reliability and safety of automotive systems to improve ground vehicle technology. The consortium is relevant to the Army for future military ground platforms.
- **Thrust areas:**
 - Automotive reliability modeling, simulation and testing
 - Automotive safety modeling, simulation and testing
 - Underbody blast modeling for occupant protection
 - Track durability with emphasis on elastomer modeling, simulation and testing
 - Condition based maintenance
 - Battle scenario simulation

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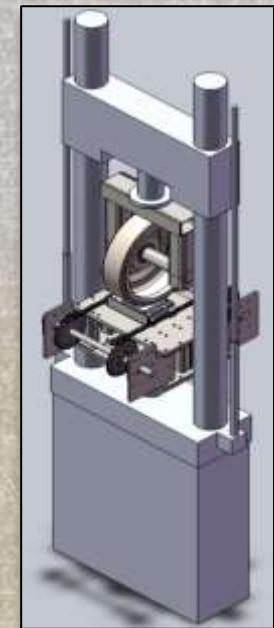
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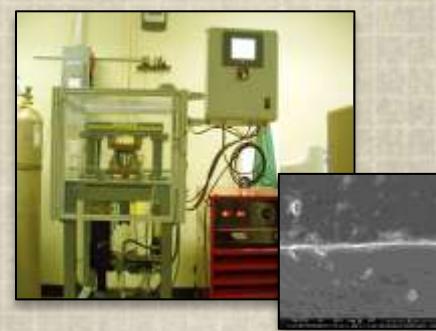
- Rapid reactive joining for lightweight armor tiles (SiC & Al-alloy)
- nCode – Identified solutions for improving Abrams track life
- **TARDEC's use of MSU high-performance computers**
- HCA development for crashworthiness design
- Loci/CHEM converted to Loci/BLAST – CFD tool for use w/blast modeling
- Study of airbag inflator location using SPH method
- Simulation & test for elastomer durability improvement
- CBM sensor network for HMMWV
- High-strain rate material property database
- Dust injection CFD for Sparks Mine Roller
- Improved behavior and visualization in realistic battle scenario simulation



Elastomer Durability

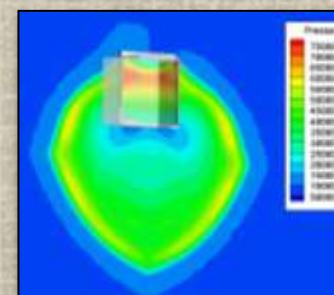


Track Test Rig
 - Multi-Channel



Rapid reactive joining

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Loci/BLAST



CBM Network sensors

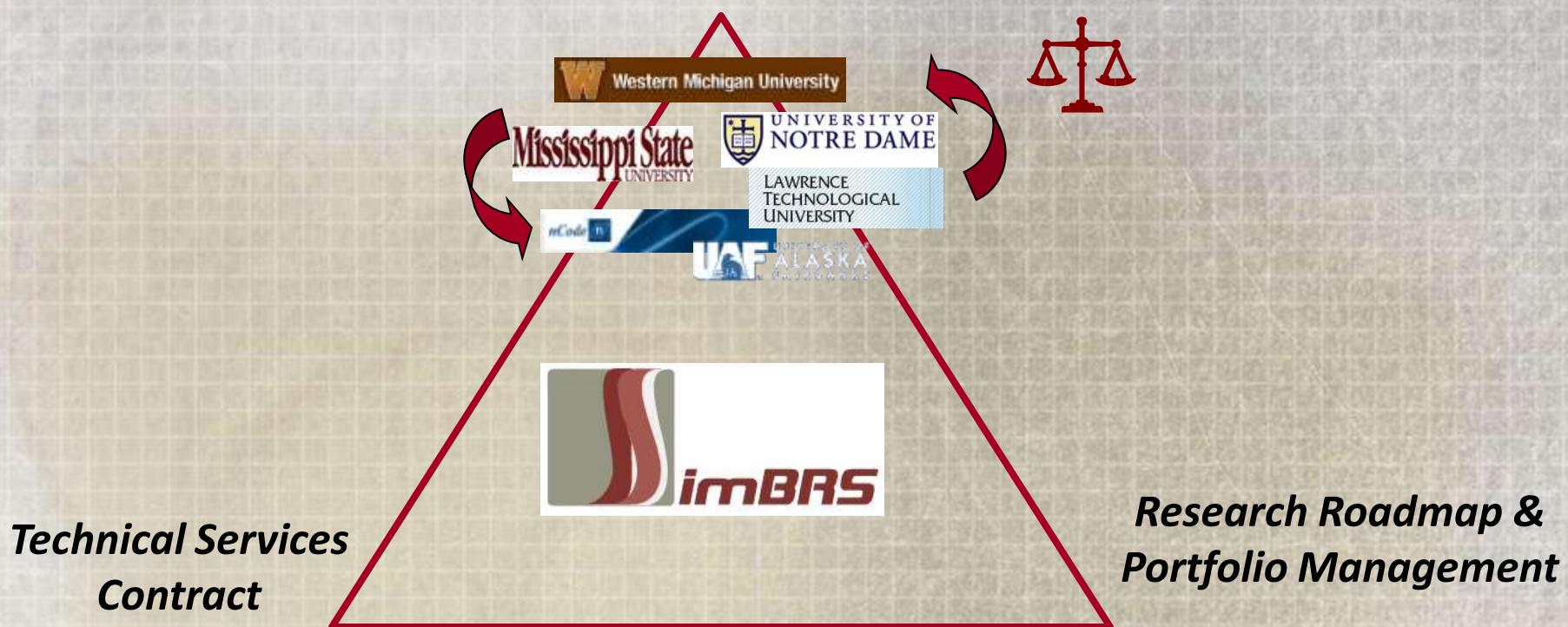
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- Academic Achievements:
 - PhD Graduates - 7
 - 4 PhD students from SimBRS into Army S&T positions
 - 3 PhD students currently employed in non-DOD positions
 - PhD in Progress - 21
 - Masters Graduates – 15
 - 1 MS student into Army S&T position
 - Masters in Progress – 10
 - Undergraduates Funded – 21
- Patents - 2
- Peer Reviewed Journal Papers – 16
- Conference Papers – 18
- Army Technical Reports – 6

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Consortium & By-laws



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It's All About the Warfighter



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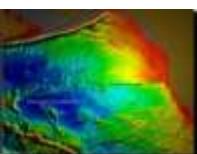
Backup Slides

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- **The High Performance Computing Collaboratory (HPC²) is a coalition of member centers and groups that share;**
 - Common core objective of advancing the state-of-the-art in computational science and engineering using high performance computing
 - Common approach to research that embraces a multi-disciplinary, team-oriented concept
 - Commitment to a full partnership between education, research, and service.
- **Goal:** to become the nation's premier interdisciplinary high-performance computing research facility.
- **Computing Power – 18th fastest computer in US academia**



The (Six) Centers of the HPC²



GeoResources
Institute (GRI)



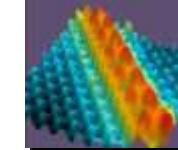
Northern Gulf
Institute (NGI)



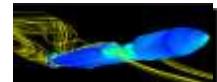
Center for
Advanced Vehicular
Systems (CAVS)



Center for DoD User
Productivity
Enhancement &
Technology
Transfer (PET)



Center for
Computational
Sciences
(CCS)



Computational
Simulation &
Design Center
(SimCenter)

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- Since May of 2008, TARDEC has awarded nearly 45 work directives on the SimBRS contract. Each are one & two year research efforts spanning a variety of topics aligned within the 19 task areas in the contract.
- During this time, TARDEC has awarded to Mississippi State University over \$33M of RDTE & customer funds. **That's an average of \$11M annually, where goal** projections were at \$15M for each option year.
- The SimBRS contract has been useful in awarding Congressional Add funds in a timely manner, setting new precedence for obligation rates at 96% by fiscal year end for the last 3 years. And nearly 98% of all awards on the contract are **Congressional Add's**.
- Over the last 3 years, MSU has been awarded 2 Congressional Adds totaling \$9.3M for their research efforts (which is approx 28% of total Adds awarded) & received an additional \$800K in administrative management charges , totaling over \$10M.

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This current list of **(19)** tasks are defined in the SimBRS Scope, encompassing a variety of M&S technology areas.

- ✓ Multi-Scale Metal Component Reliability/Safety
- ✓ Multi-scale Biomechanics Reliability Model Development
- ✓ Structural Composite Design and Reliability/Safety
- ✓ Joint/fastener and Systems Reliability
- ✓ Simulation-Based Design Optimization for Component Reliability
- ✓ Simulation-Based Design Optimization for System Level Reliability
- ✓ High Performance Computing Incorporating Physics-Based Reliability and Safety Models
- ✓ Cyber-Infrastructure
- ✓ Reliability Networking and Sensory-Based Health Monitoring for Field Applications
- ✓ Human Factors Development and Evaluation
- ✓ Computer Aided Engineering Tools for System Level Reliability
- ✓ Occupant Safety and Crashworthiness Research, Development and Testing
- ✓ Blast and Fragmentation
- ✓ Hybrid Vehicle System and Component Applicability and Reliability
- ✓ Simulation Integration
- ✓ Verification and Validation
- ✓ Supercomputing Processes
- ✓ Electronic Systems and Network Reliability
- ✓ Vehicle/Terrain Modeling

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Impact to Mission if Discontinued



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- Loss of continued augmentation of the capability for Underbody Blast Modeling, potentially with less accuracy and speed than might otherwise be obtained.
- Slowing or stopping the improvement of the elastomer durability modeling, potentially freezing the technology at current levels and hurting the effort to improve the track for Army ground vehicles.
- Significant slowing of the improvement of technology for Condition-based Maintenance, potentially causing significant impact to the roll-out of CBM for Army ground systems.
- Loss of access to High Performance Computers at Mississippi State University.
- No further participation in the consortium centered at Mississippi State University, and hence loss of access to the innovation and new technology being fostered there.
- Recruitment efforts will be hampered by loss of interaction with the U.S. citizen graduate students in technical majors who are part of the SimBRS consortium.
- Loss of new tools and software that would have improved our laboratory capabilities.

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